Management of Transjugular Intrahepatic Portosystemic Shunt–Induced Refractory Hepatic Encephalopathy with the Parallel Technique: Results of a Clinical Follow-up Study

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PURPOSE: To retrospectively evaluate the safety, feasibility, and midterm clinical outcome of the use of the parallel technique to treat transjugular intrahepatic portosystemic shunt (TIPS)–induced hepatic encephalopathy (HE) refractory to medical treatment. Additionally, factors potentially influencing clinical results after shunt reduction are assessed.

MATERIALS AND METHODS: Seventeen patients (11 men and 6 women) presenting with TIPS-induced HE refractory to medical treatment underwent shunt reduction with use of the parallel technique. West Haven HE grades before shunt reduction were IV and III in seven patients each and II in three patients. Mean portosystemic pressure gradient (PSPG) before shunt reduction was 6.8 mm Hg (range, 2–16 mm Hg). Relations between change in patients' mental state and several clinical parameters were analyzed.

RESULTS: In all patients, it was technically feasible to reduce the shunt with use of the parallel technique. PSPG after reduction increased by a mean of 5.8 mm Hg (range, 1–12 mm Hg; $P < .0001$). Mental state grades with regard to HE after shunt reduction were 0 ($n = 6$), I ($n = 4$), II ($n = 3$), III ($n = 1$), and IV ($n = 3$). Clinical improvement ($n = 7$; 41%) or complete disappearance ($n = 6$; 35%) of HE occurred in 76% of the patients, which is statistically significant ($P = .0002$). No clear relation could be established between change in mental state regarding HE and any of the potentially influencing factors.

CONCLUSIONS: Management of TIPS-induced HE with use of the parallel technique is feasible and safe. It results in an increase of PSPG, which is associated with an improvement in neuropsychiatric status in most patients.

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Abbreviations: ePTFE = expanded polytetrafluoroethylene, HE = hepatic encephalopathy, PSPG = portosystemic pressure gradient, TIPS = transjugular intrahepatic portosystemic shunt

HEPATIC encephalopathy (HE) is a common complication after creation of a transjugular intrahepatic portosystemic shunt (TIPS) (1,2). New onset or worsening of a preexisting HE after TIPS creation has been reported in 5%–47% of cases (3,4). HE is characterized by one or several neuropsychiatric symptoms and can be classified from grade I to grade IV according to West Haven criteria (5) (**Table**). In the vast majority of cases, conservative medical treatment can manage this condition successfully. However, in 3%–7% of these patients treated by conservative methods, HE remains refractory to medical management and needs further invasive treatment. Although liver transplantation remains the only definitive treatment option, various interventional techniques have been described to reduce the shunt diameter to decrease or to completely resolve the TIPS-induced HE (3,6–10). Nevertheless, the global clinical outcome after shunt reduction is unknown for all these transcatheter interventions. This study reports our experience with the parallel technique, a slightly modified shunt reducing technique recently described in a case report by Saket et al (11) that involves a combination of a balloon-expandable stent and an expanded polytetrafluoroethylene (ePTFE) stent-graft placed

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West Haven Criteria for Semiquantitative Grading of Mental State

Grade	Description
I	Trivial lack of awareness Euphoria or anxiety Shortened attention span Impaired performance of addition
II	Lethargy or apathy Minimal disorientation for time or place Subtle personality change Inappropriate behavior Impaired performance of subtraction
III	Somnolence to semistupor, but responsive to verbal stimuli Gross disorientation
IV	Coma (unresponsive to verbal or noxious stimuli)

in parallel in the previously created portosystemic shunt.

MATERIALS AND METHODS

Patient Selection

No specific approval by our institutional review board is needed for retrospective analysis; informed consent was obtained from all patients before TIPS creation and before shunt reduction.

Between September 1992 and September 2006, 317 patients underwent TIPS creation at our institution. In 31 of these 317 patients (10%) TIPS reduction was needed as a result of debilitating clinical signs of TIPS-induced HE unresponsive to medical therapy. In the first 16 patients, the shunt was reduced with use of different interventional techniques and devices, including bare reduction stents and reduction stent-grafts, as described elsewhere (12). The remaining 15 patients and two other patients with a previously created but clinically failing shunt reduction (six women and 11 men; mean age, 58.9 years; range, 45–79 y ± 10.9 [SD]) were included in the study. In the latter two patients, the portosystemic shunt was previously reduced with use of a Memotherm reduction stent (Angiomed, Karlsruhe, Germany) with an inner constrained lumen 5 mm in diameter, in which an ePTFE-covered stent-graft (Viatorr; W.L. Gore & Associates, Flagstaff, Ariz) was placed. After a technically successful reduction, neuropsychiatric scores remained Grade II and Grade IV, respectively. The latter shunt reduction procedures were performed from July 2004 to July 2006. Our institutional medical treatment protocol for TIPS-induced HE consists of increased dietary fiber intake, administration of lactulose (Bifiteral; Solvay Pharma, Brussels, Belgium), and an antibiotic cocktail of neomycin, metronidazole, and amoxicillin if necessary. The underlying liver disease in the studied patients was alcoholic liver cirrhosis (n = 11), nonalcoholic steatohepatitis (n = 2), hemochromatosis-induced liver cirrhosis (n = 1), veno-occlusive disease (n = 1), hepatitis C cirrhosis (n = 1) and cryptogenic liver cirrhosis (n = 1). Patients were categorized in Child-Pugh class A (n = 3), B (n = 7), and C (n = 7). Indications for initial TIPS creation were variceal bleeding (n = 8), refractory ascites (n = 7), and hepatic hydrothorax (n = 2). Mean portosystemic pressure gradient (PSPG) before shunt creation at that time was 16.9 mm Hg (range, 3–62 mm Hg). In all 17 patients, the portosystemic shunt was created as described previously (13) by placement of an ePTFE-covered nitinol stent (Viatorr, W.L. Gore & Associates) and then dilated with a 10-mm angioplasty balloon (Wanda; Boston Scientific, Natick, Mass) in case of bleeding and with an 8-mm angioplasty balloon (Wanda; Boston Scientific) in case of refractory ascites or hepatic hydrothorax. Clinical and neuropsychiatric assessment of HE the day before TIPS reduction was made by two experienced hepatologists (F.N. and C.V.) in accordance with West Haven criteria for semiquantitative grading of mental state (5): grade II (n = 3), grade III (n = 7), and grade IV (n = 7). Clinical evidence of refractory HE and the subsequent decision to perform an endovascular shunt reduction with the parallel technique was made at a mean of 2.6 months (range, 5 days to 18 months) after the initial TIPS creation (n = 15) or previous shunt reduction with placement of a Memotherm reduction stent in which a Viatorr stent-graft was placed (n = 2).

TIPS Reduction Procedure

Depending on the grade of HE and the general status of the patient, the shunt reduction procedure was performed under general (n = 5) or local anesthesia (n = 12). No additional sedation was given to the patients if the procedure was performed under local anesthesia. In all patients, venous access was obtained by a right jugular approach (40 cm long, 10-F sheath; Cook, Bloomington, Ind) and a right femoral approach (45 cm long, 8-F Super Arrowflex sheath; Arrow International, Reading, Pa). The portal vein main trunk was cannulated through the TIPS with a 4-F Cobra catheter (Slip Cath; Cook) via a right femoral and right jugular approach in all but one patient. In one patient, an additional 8-F Arrow sheath was placed from a right jugular approach because of inability to catheterize the TIPS from the femoral access. Measurements of the portal and systemic pressure resulted in a mean PSPG of 6.3 mm Hg (range 2–12 mm Hg) in the group of 15 patients without a previous reduction; in the remaining two patients presenting with persistent clinical signs of debilitating HE after a previous shunt reduction, as described earlier, the residual PSPG measurements were 5 mm Hg and 16 mm Hg, respectively. After measuring the portal and systemic pressure exchanging the catheters for stiff guide wires (Amplatz wire; Cook), a balloon-expandable stent (Express Vascular LD; Boston Scientific) with a length of 17 mm and a diameter of 6 mm (n = 15) or 7 mm (n = 2) was positioned in all but one patient by a femoral approach in the middle third of the initial TIPS stent-graft, and afterward an ePTFE-covered nitinol stent (Viatorr; W.L. Gore & Associates) with a nominal diameter of 10 mm was positioned parallel to the balloon-expandable stent, thereby completely covering the initial TIPS stent-graft. The balloon-expandable stent was placed first, and afterward, with the balloon still inflated, the stent-graft was deployed as previously described (13). The balloon was then deflated and gently removed together with the stiff guide wire. Finally, completion portography was performed and repeated PSPG measurements were made (**Fig 1**). In case of reopacification of fundal and/or